The Green House Shows the Way

The retrofit of existing homes for energy performance is a complicated issue—for building professionals and homeowners alike. In an effort to translate lessons learned in new construction to retrofit projects, Integrated Building and Construction Solutions (IBACOS), an industry collaboration dedicated to bringing innovation to the home-building industry, has been working through the DOE's Building America program to develop systems engineering approaches to retrofit activity.

Building America has started a new focus on research to increase the efficiency of existing housing 20%–30% above the 1993 Model Energy Code benchmark. The 30% level of improvement qualifies a house as an Energy Star home. The program has been seeking ways to assist homeowners in planning and prioritizing retrofit measures.

A House That Teaches

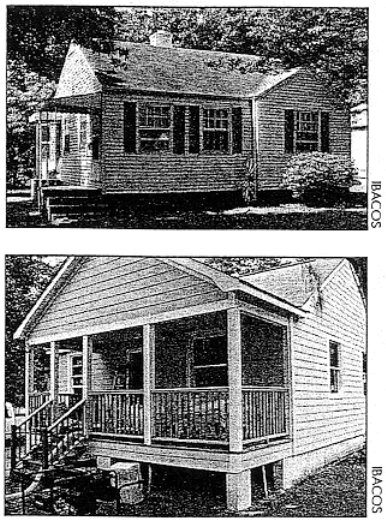
IBACOS has begun putting new ideas into old houses with a project called the Green House, located in the Noisette community in North Charleston, South Carolina. The Noisette community encompasses approximately 350 acres of a former U.S. Naval base and more than 3,000 acres of existing community—including residential, commercial, industrial, and institutional buildings. Project partners are the Noisette Company—the developer—and the Sustainability Institute—a nonprofit sustainability advocacy group.

The Green House project focuses on the renovation of one house, with an emphasis on sustainability. The building is approximately 60 years old, roughly 870 ft², and typical of the homes in the region. It is now a demonstration home that can be used to educate residents of the community on sustainable renovation and retrofit strategies that are applicable to their own homes. Helping residents to understand how individual renovation activities impact other systems in the house is seen as vital, regardless of how many different measures are implemented at once.

As part of its approach, IBACOS created a prioritization list that allows homeowners to address renovation measures in order of importance:

- Ensure structural integrity;
- Manage bulk moisture;
- Develop a water vapor control strategy;
- Develop an indoor air quality strategy (IAQ);
- Develop a thermal control strategy;
- Develop a mechanical system strategy; and
- Develop a lighting and appliance strategy.

At the most basic level, this prioritized list educates homeowners about the fundamental concepts of housing performance. For example, it is not useful to expend resources to improve IAQ if the basic structure of the home is unsafe. Similarly, if bulk moisture is not prevented from entering the building, there is little sense spending significant resources to improve the efficiency of the mechanical system. It is hoped that if consumers are educated, fundamental improvements will be made—or at least considered—before purely cosmetic improvements are undertaken. (Perhaps this is wishful thinking, considering that about 20% of home improvements are improvements to kitchens and baths.)



Before the retrofit *(top)*, the Green House had a HERS score of 57. The retrofitted house *(bottom)* received a HERS score of 89.

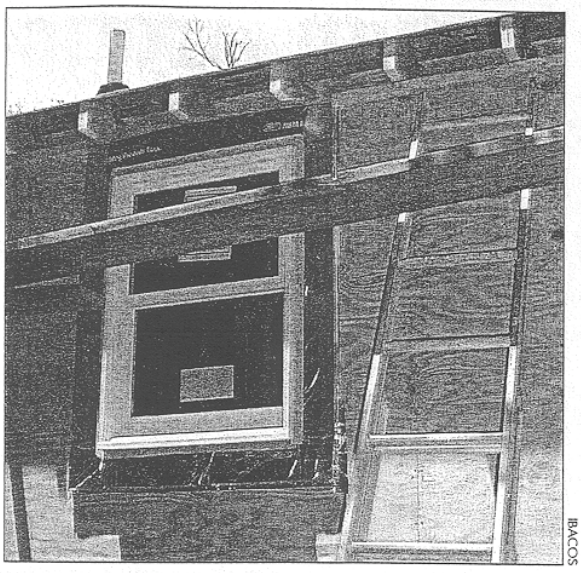
System synergies are evaluated after the priorities are established. All of the potential interactions of changes made to the Green House were evaluated against other improvements being considered. For example, if a resident decides to replace windows for aesthetic reasons, the implementation of high-performance glazing can yield comfort and energy savings. Reduced heat gain through windows will reduce the energy used for cooling, and, when the mechanical system needs to be replaced, will allow for a downsized A/C or heat pump (or possibly for eliminating the A/C altogether in marginal climates). It is equally important to ensure that proper flashing is installed when the windows are replaced, to prevent water from leaking into the building envelope. Such leaks could cause rot, mold growth, and degradation of the insulation system.

As a first step in helping homeowners to understand such system synergies, IBACOS developed a matrix that identifies major retrofit work items and possible systems-engineering strategies that can optimize energy efficiency, durability, safety, and comfort. This system-interactions matrix is used to inform homeowners and renters about the relative impacts of the decisions that they make. This approach can also be taught to builders and retrofitters as a way to enhance the value of the services they provide.

Green House Energy Retrofit

Before the retrofit, the Green House had a HERS score of 57. With energy improvements, it achieved a HERS score of 89. To achieve this level of improvement, the retrofit, which was done in 2002, focused on the following issues:

- Improving the building envelope. This was done through increased insulation on the exterior walls (R-13) and the ceiling (R-38); new double-glazed, low-e windows; and extensive air sealing.
- Controlled mechanical ventilation and dedicated dehumidification. The dedicated dehumidifier was installed because, in Charleston, there are statistically more than 3,000 hours when the outdoor tem-


IBACOS

The extended eaves and flashing around the windows provide bulk moisture control in the wall assembly.

perature is between 65°F and 75°F. At the same time, there is a relatively high mean coincident wet-bulb temperature. Dedicated dehumidification was installed to help maintain lower indoor relative humidity, and to help minimize the potential for mold growth. In addition, multispeed A/C equipment with a humidity-sensing thermostat was installed. This system is designed both to look at the rate of temperature reduction and humidity control, and adjusts the speed to increase latent capacity when humidity control is more important than temperature control. This system only works when there is also a need for cooling, so IBACOS specified the dehumidifier as well, recognizing that there are a significant number of hours every year when cooling is not needed, but humidity control is still desirable.

• Providing a high-efficiency two-speed 14.5-SEER 8.0 HSPF heat pump system, with the airhandling unit located within the conditioned space.

• Installing a new duct system on the attic floor, with joints sealed with mastic and buried in the R-38 attic insulation.

• Extending eaves and installing a continuous drainage plane with integrated flashings for bulk moisture control in the wall assembly. Eave extensions were done by removing roofing and plywood at the perimeter of the building, and adding solid-wood eaves, including hurricane clips (see photos).

• Creating an insulated, nonvented crawlspace with a sealed continuous vapor barrier over exposed earth.

Many of the items were originally recommended to improve energy performance, while others were implemented as a result of aesthetic modifications made to the house. IBACOS projects that these systems-engineered improvements will reduce the annual energy costs of the Green House by 79%, compared to the original house before it was retrofitted.

Expanding the Matrix

IBACOS is continuing to work to expand the systems synergies matrix, based on the needs of the community and of the state of South Carolina. In addition, the IBACOS communications team is working with the Sustainability Institute to translate this information into simple language that homeowners who tour the Green House can easily understand.

— Duncan Prahl and Stacy Hunt

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For information on the Noisette Company, go to www.noisettesc.com.

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